TITLE: SIZE DISCRIMINATING DUAL ELEMENT PIR DETECTOR

FIELD OF THE INVENTION

5   The present invention relates to detectors for alarm systems, and in particular relates to detectors useful in discriminating between small pets and intruders.

BACKGROUND OF THE INVENTION

There are a host of different intruder alarm
10   detection systems now on the market and many of these alarm systems are remotely monitored. In such systems, the detection of an alarm condition typically results in the alarm being reported to the police. Unfortunately, false alarms are a nuisance to the police forces and take them
15   away from other important matters. One source of false alarms is caused by pets, and in particular small domestic pets. Screening of the lower ground level of the area being monitored is a common practice to reduce false alarms from pets, however, this approach is not effective for some
20   small pets that have a tendency to climb. Domestic cats can cause problems for security systems.

The present invention seeks to overcome the problems of false alarms caused by small, domestic pets.

25   SUMMARY OF THE INVENTION

An infrared intrusion detector, according to the present invention, comprises a housing having two passive infrared (PIR) receiver arrangements where each passive infrared receiver arrangement includes a lens arrangement
30   for focusing infrared (IR) radiation from predetermined

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zones within a space to be monitored. Each lens
arrangement directs received radiation onto a PIR sensor,
which produces a signal based on this received radiation.
The detector has signal processing means connected to the
5   sensors which processes the signals and evaluates the
processed signals for sufficient IR radiation indicative of
an alarm condition. The lens arrangements define
alternating zones where one zone is associated with one PIR
receiver arrangement and the next zone is associated with
10   the other PIR receiver arrangement. Adjacent zones are
separated by an upwardly narrowing nonactive zone which
provides the detector with a vertical discretion
characteristic. This detector provides for size
discrimination of moving IR radiation sources within the
15   monitored space and is able to reduce false alarms caused
by pets.

BRIEF DESCRIPTION OF THE DRAWINGS

        Preferred embodiments of the invention are shown in
20   the drawings, wherein:

        Figure 1 is a schematic of an infrared intrusion
detector;

        Figure 2 is a schematic showing the beams of the
detector;

25   Figure 3 is a top view showing various beams of the
bottom passive infrared receiver arrangement of the
detector;

        Figure 4 is a side view showing various beams
associated with the bottom passive infrared receiver
30   arrangement; and

        Figure 5 is a front view of a flexible lens
arrangement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A dual element passive infrared detector 2 is shown in Figure 1. The detector 2 has a housing 3 containing an upper PIR receiver arrangement 4 and a lower PIR receiver
5   arrangement 6. The upper PIR receiver arrangement has a lens 8 which focuses selective infrared radiation from an area to be monitored 51 onto a sensor 10. The lower PIR receiver arrangement 6 also has a lens 14 which selectively focuses infrared radiation onto the sensor 16. An example
10 of the combined lenses 8 and 10 is shown in Figure 5.

The housing 3 has a back wall 5 for mounting to a wall of a premise at a raised position. Each of the sensors 10 and 16 are tilted forwardly approximately 6° to look downwardly. The signals from the sensors 10 and 16
15 are evaluated by the processor 12. An alarm signal is produced at 24 if the evaluation indicates an alarm condition.

Figure 2 shows how the upper lens 8 and the lower lens 14 cooperate for monitoring of the area 51. The
20 passive infrared detector 2 is shown mounted on a wall or similar structure at an elevation of approximately $7^{1/2}$ feet from the floor. The lens arrangement is looking forward and monitors the space 51. The distance grid along ground level is shown and it can be seen that two series of active
25 zones 30 and 32 which alternate and are separated by a series of nonactive zones 34. The nonactive zones progressively narrow between active zones in a direction back towards the sensor. Zone 30 defines a response region where infrared radiation within the region is focused by
30 the lens arrangement onto sensor 16. Infrared radiation within beams 32 is focused onto sensor 10. Infrared radiation in the nonactive zone is not focused on a sensor. The area from about five to forty feet from the base of the detector at ground level, is covered by the alternating
35 series of zones 30 and 32. It can also be seen that the

zones within about twenty-five feet of the sensor are relatively narrow and the nonactive zones define a considerable region, particularly within about two feet of ground level. With this spacing of the beams, a small pet,

5   such as a domestic cat, is of a size less than approximately two feet in height and cannot cause sufficient infrared radiation to be received by both of the sensors 10 and 16 to produce an alarm. For example, a cat at twenty feet could be exposed to the beam 32 of the upper

10   sensor 10, but the cat at ground level is not of sufficient size to also cause a high response in the active zone positioned at about fifteen feet where radiation will be focused on the sensor 16. It can also be seen that the active zones tend to diverge, however, there is still

15   considerable spacing of the beams between two and three feet above ground level. The spacing between the active zones above the two foot level narrows, rendering this region more responsive to infrared radiation sources. In this way, the detector provides vertical discrimination.

20   The alternating zones 30 and 32 separated by the progressively narrowing nonactive zones produce vertical discrimination where the sensor within about twenty-five feet of the sensor is able to distinguish small domestic pets at ground level from larger and taller human

25   intruders. Basically, the region within two feet of ground level and within twenty-five feet of the sensor is less responsive than a corresponding area above this two foot level. Small domestic pets have a large percentage of their volume normally in this lower region and false alarms

30   from small domestic pets is reduced.

It can be seen that beyond approximately twenty-five feet, due to the divergence of the beams, the dead zone 34 between adjacent beams is becoming smaller. Fortunately, the amount of radiation received from a small

35   domestic cat at these distances also decreases as a function of the distance. For this reason, the detector is

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not responsive to such a small infrared body, but would be responsive in a distance from six to approximately twenty feet if the upwardly narrowing nonactive zones were not present.

5   Figure 3 also illustrates how a pattern of zones is used to cover the space 51 being monitored. As shown in the sectional view of Figure 4, there is a distant set of zones, generally indicated as 53, two intermediate sets of zones, indicated as 55 and 57, and a close series of zones

10   59. The exact position of these zones is determined by the Fresnel lens shown in Figure 5. The lens 40 of Figure 5 has an upper section 42 and a lower section 44. Each of the sections 42 and 44 are divided horizontally and vertically to cover different areas of the region, and

15   thus, define the alternating active zones separated by the narrowing nonactive zones.

       A review of Figures 2 and 4 show how the response area of each zone 30 or 32 narrows as the distance from the detector decreases. This takes into account the higher

20   levels of IR radiation received as the distance from the detector decreases.

       The passive infrared detector has been described with respect to the benefits in discriminating small, domestic pets from human intruders. Cats have previously

25   posed considerable problems, as they can climb and even though they are relatively small, they can enter an area substantially above ground level, resulting in the detector receiving a relatively high level of infrared radiation and resulting in an alarm condition. With the present

30   invention, the area immediately adjacent the detector should be kept free of chairs or other objects which would allow a cat to establish itself at a high point in front of the detector. If the cat is at a low level, such as ground level or below about $2\frac{1}{2}$ feet, it will cause considerable

35   radiation to be received by one sensor, but the cat is not of sufficient size to cause a similar result in the other

sensor. In contrast, a human intruder, due to the much
greater size and height, will cause a high response in each
sensor, causing an alarm to be produced.

The signals from the sensors 10 and 16 can be
5   evaluated in a number of different ways. In the preferred
form, each signal is evaluated at different amplitude
levels and processed as described in U.S. Patent 5,444,432,
incorporated herein by reference. In this case, each
signal is evaluated separately and an alarm signal is
10   produced when both signals exceed a standard. Basically,
the lens arrangement has rendered the area below two feet
and within twenty-five feet of the detector less sensitive
than a corresponding area above the two foot level. Other
systems have tried to identify infrared radiation from pets
15   and in contrast, the present invention reduces the
possibility of receiving sufficient radiation from pets to
cause an alarm.

A simple approach for evaluating the signals from
the two sensors is to merely add the two results and then
20   compare this result with a predetermined threshold. A
small domestic animal, such as a cat, does not produce a
response of sufficient magnitude in each sensor to cause it
to exceed the alarm threshold. In contrast, an intruder,
due to its size and normal vertical orientation, produces
25   sufficient IR radiation to be immediately detected. This
arrangement provides a simple approach for discriminating
between different sizes of radiation sources. It has also
been found that pets, such as dogs, of average size can
also be discriminated in this way. It can be appreciated
30   that the detector can also easily be adjusted for a
particular application, if desired, by providing a variable
threshold. In this case, depending upon the particular
animals, thresholds can be set such that the animal does
not cause an alarm while still being sensitive to a human
35   intruder. A person can easily check this merely by setting
the detector for the particular pet and then testing the

system by entering the space himself and noting when a
detection is made or using other test specimens, such as
children. This arrangement provides a very efficient
manner for size discrimination of moving IR radiation
5   sources while still providing effective coverage of the
space being monitored from unwanted intruders.

Although various preferred embodiments of the
present invention have been described herein in detail, it
will be appreciated by those skilled in the art, that
10   variations may be made thereto without departing from the
spirit of the invention or the scope of the appended claims.